IMAGES OF WOMEN IN ENGINEERING TEXTBOOKS

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Introduction

Today I will discuss preliminary results of a content analysis of introductory engineering textbooks. The larger project, of which this is a part, seeks to answer questions about the ways in which the content of these books has changed over the past 40 years as well as to explore the reasons for those changes. Though I will be talking about one small element of content today, namely portrayals of women with respect to men, a number of other elements of content will be examined as this project progresses.

Lately there has been quite a bit of interest - as evidenced by many of the items on the WEPAN computer bulletin board - in issues regarding the "climate" for women at engineering schools [1][2][6][8]. Concern for climate issues is well-placed. Because there are so few women at engineering colleges, women often occupy and are forced to play the role of "tokens," whereby increased visibility and difference have important social implications [4]. At a practical level, if women encounter a chilly climate at engineering school, the likelihood that they will persist in their education at such places will be adversely affected.

The project I will describe today examines one of several possible elements of engineering school culture: textbooks. Specifically, I am interested in examining texts that are not dissimilar from introductory texts in other disciplines, designed to introduce the student at an early point in time to the profession and the methods and the issues with which practitioners of that profession are concerned.

Why do textbooks matter? There is a large literature about sexism and racism in books that indicates that students do, indeed, internalize the stereotypes they view in the printed media [3][7][9][10][11]. Furthermore, it is not the specific books or their images, per se, which is at issue. Instead, the images I analyze in these books should be taken as symptomatic of engineering culture, other elements of which may be more difficult to analyze than printed media. Textbooks are a material element of engineering culture. The portrayals of different types of people in engineering texts not only reflects the norms and values of the authors, but is also a form of occupational socialization aimed at instilling in potential occupation holders the necessary norms and values associated with the occupation.

In line with this project, I will answer two questions today. First: How have portrayals of women in first year engineering texts changed over time? Second: What are the differences in the ways men and women are portrayed in introductory engineering texts?

Data and Methods

The primary research method I employ in this study is content analysis. The primary benefits of content analysis are that it is an unobtrusive method and that it often examines media that are a matter of public record. In social science research, unobtrusive methods are preferred because the researcher cannot influence "respondents" [5]. Content analysis is particularly useful in examining the subtle, often unstated messages in books, movies, and other media that affect us, the viewers and readers nonetheless.

The data I will present today were collected from an analysis of twelve introductory engineering texts. This represents merely one fourth of the texts that will be included in this study, hence, the results I will discuss today should be taken with caution. The texts are grouped into four historical eras, three of which will be discussed today. The first is the "pre-EEO era" of 1950-1971. The second era is the "early transition era" of 1972-1977, while the third is the "late transition era" of 1978-1985. Finally, what I have termed the "current era" of 1986-1994 is coded separately since enrollments of women relative to men's at engineering schools levelled off during the late transition era. My current results are based on a sample of five books from each of the first and third eras and two books from the last era.

Sampling of texts has been constrained due to lack of research funds to purchase books. Books were obtained from the New Mexico State University library and from a local used book store. Only books that indicated in either the preface, introduction or in the "note to instructor" section that the book was designed for use in a first year college classroom to introduce students to the type of work that engineers do were included. Hence, all of the books are a particular type, designed specifically to address concerns of occupational socialization.

A series of five content coding forms were developed and used to describe the content of each text. Since I was primarily interested in the pictures, drawings and cartoons in the books, I merely sampled the text for evidence of gendered terminology. The coding sheets were used to describe and categorize the visual images in each book. The race and sex of each person shown in the text was recorded. The total number of pictures (excluding line drawings for mechanics and electric circuits problems), the total number of pages and the type of topics covered in each text were recorded. The total number of pictures in which people were shown was also recorded.

For each picture each person's role in the picture was recorded. There were three basic roles a person could fulfill in each picture. First, the most frequent category, was "Active". People who were shown working or engaging in some activity were coded as "active". Second, there were "Portraits" of famous scientists and engineers. Third, if a person is shown as incidental to the photo, used to show scale or is not working at something, then the person was coded as a "Model".

Two other elements of content were assessed. Sexual content of pictures was recorded as a binary variable in addition to the "Active-Model-Portrait" scheme. Sexual content was defined as pictures in which sexuality is emphasized or exaggerated, such as pictures of people in bathing suits or tight-fitting clothes. Finally, I was interested in the extent to which women were depicted in stereotypicaly female ways. Females who were engaged in occupations in which more than 80% of the occupation holders were women (such as housewife, secretary, data entry, teacher, nurse, etc.) were coded as stereotyped.

Results

Quite a bit of information was gleaned from the texts I analyzed. Unlike other engineering texts, because these books are more like those used in introductory classes in other disciplines, these books feature numerous pictures so that students can see what engineers do. I will discuss the following summary measures today:

1. Average Pictures per Book
2. Average Pictures of People per Book
3. Percentage of pictures of people in which women are shown.
4. Percentage of people in all pictures that were women.
5. Rates at which women and men are shown as "Active", "Portraits" or "Models".
6. Rates at which females are shown as "sexualized" or "Models" versus males.
7. Rates at which females are shown in stereotypicaly female work roles.

Tables 1 and 2 summarize the results to date. Data for only three of the four historical eras I have specified were available for analysis. The results shown here should be taken with caution, since statistically significant sample sizes have not been obtained nor have additional coders been used to establish a reliability index of the instrument.

Conclusions

The preliminary results shown here indicate that women were more likely to be portrayed in introductory engineering texts in the later two eras than during the 1950's and 1960's. It is interesting to note that prior to the 1980's, the usage of the masculine personal pronoun was the rule, whereas such usage declined during the third era (1978-1985) and was not used at all in either of the two texts from the late 1980's.

When women were shown in earlier texts, they were more likely to be shown in stereotypicaly female occupations. None of the women in the early texts was identified as being an engineer. In contrast, in the texts from 1978-1985 and 1986-1994, women were often portrayed as engineers and were shown less often in stereotypicaly female occupations. During these latter periods, however, women were far more likely than men to be used as models. Also, during the "late transition era" of the early 1980's, women were more often sexualized, often in cartoons.

Should the general trends shown in these preliminary data be borne out in further research on this project, a general understanding of changes in engineering culture will be explicated from this research. Based on these preliminary results, Kanter's theory of change in relative numbers [4] and prior research on women in engineering [1],2], and [6], I will take a moment to speculate about the process of engineering cultural change. In the early period, 1950-1971 engineering schools discriminated against women, which essentially closed the occupation to all but the most persistent and dedicated women. The texts from this era reflect the masculine nature of engineering culture during this timeframe.

During the early transition period, engineering schools were no longer permitted by law to discriminate against women. However, except for a few colleges, few schools initiated wide-spread recruitment of women. As with any social change, especially those concerning occupations and gender, resistance to change was probably quite strong. During this 5-year period from 1972-1977, there was not a vast improvement in the number of women pursuing engineering degrees at the post-secondary level. Access to information about engineering was still quite limited for most women as was access to the educational preparation necessary to successfully pursue an engineering degree.

The late transition period is that period in which the greatest changes should be evinced since enrollments of women were increasing during this time. The data here show this (though again, because of the limitations of the data, caution in interpretation is

advisable), but also show a certain amount of persistence of sex-based attitudes in engineering texts. These texts often featured cartoons in which the object of humor was gendered. The data presented here showed that it is during the late transition period that women continued to be shown in stereotypicaly female roles, were far more likely than men to be used as models and were far more likely to be shown as sexualized. It is the combination of these three features of content, combined with the continued use in some texts of the masculine personal pronoun that indicates a rather grudging acceptance of women in the field.

Finally, during the current era enrollments of women have, essentially, levelled off at many schools. Engineering educators often indicate that it seems like "20% female" is an invisible upper limit as to the number of women they can attract to their programs. The use of the masculine personal pronoun has been eliminated - though the cause could be publisher's guidelines rather than self-control. Women are far less likely to be shown in female sex-typical jobs and are far more likely to be shown as engineers and scientists. Neither of the books from this era analyzed to date featured sexual content or cartoons.

In conclusion this paper has demonstrated the use of content analysis as a tool for analyzing a material element of engineering college culture. Though the authors of engineering texts probably didn't intend to convey messages about the gendered nature of engineering culture, it is clear given the data presented here that their texts portray men and women differently. Understanding the ways in which engineering college culture might be chilly towards females is important in understanding the special problems that women face at engineering schools beyond those faced by their male peers. The chilly climate at engineering colleges is one of several obstacles that cause women to pursue other occupational options rather than engineering.

Roles	ERA 1: 1950-1971		ERA 3: 1978-1985		ERA 4: 1986-1994	
	Male	Female	Male	Female	Male	Female
Active	82.0%	94.4%	93.8%	87.7%	97.3%	88.0%
Portrait	0.5%	0.0%	5.3%	1.5%	0.9%	0.0%
Model	17.5%	5.6%	0.9%	10.8%	1.8%	12.0%

Table 1. Distribution of Males and Females Among Role Types

Variables	ERA 1 1950-1971	ERA 2 1978-1985	ERA 3 1986-1994
Sample Size	5	5	2
Pages per Book	219.8	444.2	360.0
Pictures per Book	58.0	114.8	72.0
Pictures per Page	.26	.25	.19
Pictures of People per Book	17.8	54.6	34.0
Pictures of People as a % of All Pictures	31%	48%	47%
Females as a % of All People in Pictures	6%	14%	17%
Percent of All Pictures Containing Females	10%	22%	21%
"Sexualized" People per Book	0.2	2.0	0.0
Females as a % of All People "Sexualized"	100%	96%	N/A
People Shown as "Models" per Book	7.4	2.2	2.5
Females as a % of All "Models"	2.7%	67.9%	58.3%
Stereotypical Females as a % of All "Active" Females	41.5%	30.9%	5.0%

Table 2. Means for Each Era on Independent Variables of Interest

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